Clearance of Subarachnoid Clots after GDC Embolization for Acutely Ruptured Cerebral Aneurysm

Comparison with Early Direct Surgery

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Summary

It is apparent that subarachnoid clots play an important role in the development of delayed vasospasm that is one of the major causes of mortality and morbidity in patients with acutely ruptured cerebral aneurysm. The purpose of this study is to compare the clearance of subarachnoid clots in the acute stage after the treatment with Guglielmi detachable coils (GDC) and after treatment with direct surgery.

Forty-nine patients were treated by GDC embolization within four days of the ictus. After GDC embolization, adjunctive therapies, such as ventricular and/or spinal drainage (67%), intrathecal administration of urokinase (41%), continuous cisternal irrigation (16%), and external decompression (16%), were performed. Seventy-four surgically treated patients were subsequently treated by continuous cisternal irrigation with mock-CSF containing ascorbic acid for ten days. The clearance of subarachnoid clots was assessed by the Hounsfield number serial changes on the CT scans taken on days 0, 4, 7, 10 after subarachnoid hemorrhage.

The incidence of symptomatic vasospasm was lower in the GDC group (6%) than in the surgery group (12%). The clearance of subarachnoid clots from both the basal cistern and the Sylvian fissure was more rapid in the GDC cases than in the surgery cases in the first four days. Intrathecal administration of urokinase accelerated the clearance significantly.

GDC embolization followed by intrathecal administration of thrombolytic agents accelerates the reduction of subarachnoid clots and favorably acts to prevent delayed vasospasm.

Introduction

Early surgical intervention followed by aggressive management against delayed vasospasm has now been the standard treatment for the patients with acutely ruptured cerebral aneurysm. However, delayed vasospasm still remains one of the main leading causes of permanent neurological disability and death in these patients. We have reported that the incidence of symptomatic vasospasm in the patients treated with Guglielmi detachable coils (GDC) was lower than that in the surgically-treated patients [1,2].

Though the mechanisms of delayed va-

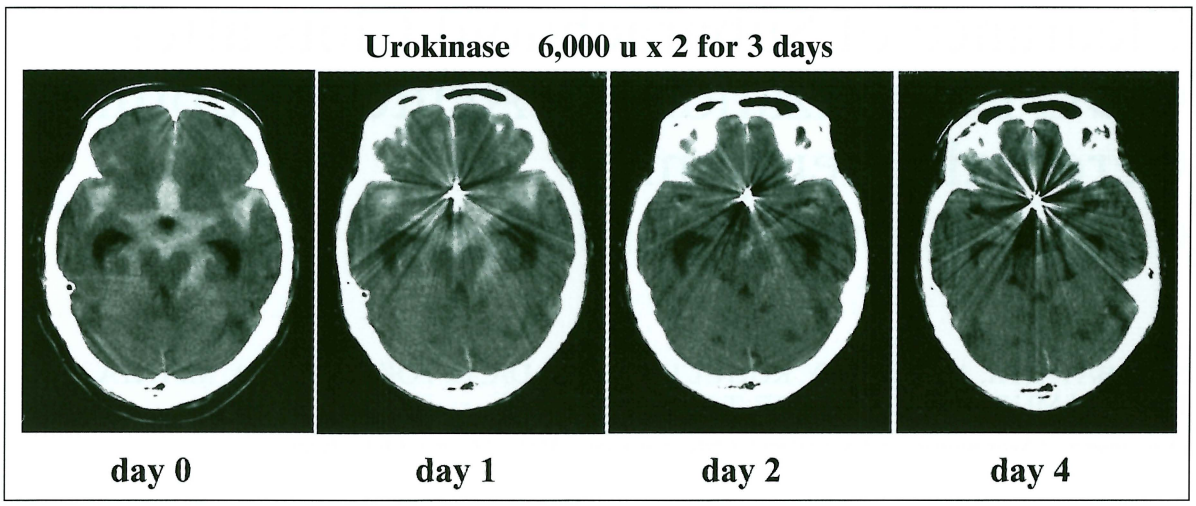

Figure 1 Serial CT scans of a representative case treated with GDC embolization.

sospasm have not been fully understood, its occurrence has been known to be related to subarachnoid clot density. Therefore, we studied, in the present study, clearance of subarachnoid clots both in the patients treated with GDC and direct surgery.

Patients and methods

We basically choose GDC embolization for the patients whom direct surgery is not suitable due to their poor neurological and/or general conditions or advanced age, as well as the location and multiplicity of aneurysms.

This retrospective analysis was undertaken in a series of 49 cases treated with GDC embolization within four days of the ictus (GDC-treated group) and in 74 patients treated with direct surgery as the control (surgically-treated group).

After GDC embolization, the patients were treated in the intensive care unit with the same protocol as that used for the surgically-treated group. The post-operative protocol is normovolemic hyperdynamic therapy with administration of calcium channel blockers and some other agents.

For the patients in the GDC-treated group, ventricular and/or spinal drainage was introduced in 67% (33 out of 49), urokinase was intrathecally administered in 41% (20 out of 49), continuous cisternal irrigation was performed in 16% (8 out of 49), and external decompression was performed in 16% (8 out of 49). For all 74 surgically-treated cases, continuous cisternal irrigation with moc-CSF containing ascorbic acid was performed for 10 days.

Following factors were studied: 1) incidence of symptomatic vasospasm (SVS) in the GDC-treated and surgically-treated cases, 2) clearance of subarachnoid clots from the basal cistern and the Sylvian fissure in 15 GDC-treated and 18 surgically-treated cases, 3) The effect of intrathecal urokinase administration on the clearance of subarachnoid clots. Clearance of subarachnoid clots was assessed by serial changes of the Hounsfield number on the CT scans taken on day 0, 4, 7, and 10 after subarachnoid hemorrhage (SAH).

Results

1) *Incidence of symptomatic vasospasm*

The incidence of symptomatic vasospasm in the surgically-treated group was 12%, whereas that in the GDC- treated group was 6%.

2) *Clearance of subarachnoid clots from the basal cistern and the Sylvain fissure*

Figure 1 shows the serial CT scans in a representative case with ruptured A-Comm aneurysm (74 y.o. male, Hunt & Kosnic Grade 4). This patient was treated with GDC embolization on Day 0 and then intrathecally administered with 6000 units of urokinase twice a day for the following three days. Subarachnoid clots looked completely cleared out by Day 4.

Figure 2 shows reduction of the Hounsfield number in the basal cistern and the Sylvian fissure after SAH. Reduction was more rapid in the GDC-treated group than in the surgically-0

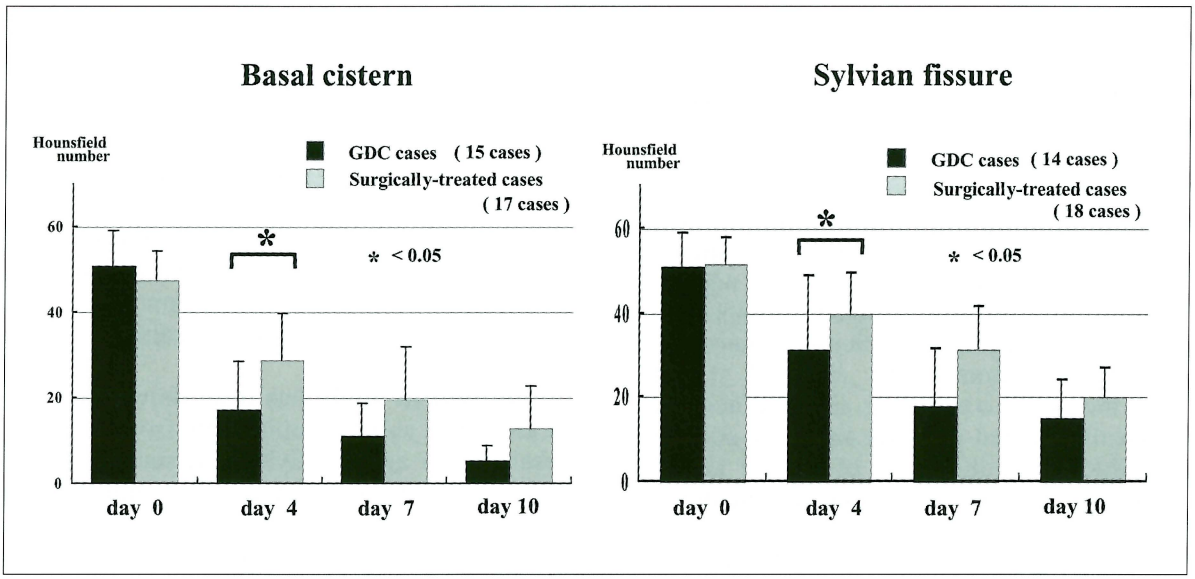

Figure 2 Serial changes in the Hounsfield number of the basal cistern (left) and the Sylvian fissure (right) in the GDC-treated group and the surgically-treated group.

3) *Effect of the intrathecal urokinase administration on the subarachnoid clots clearance*

In the basal cistern, reduction of the Hounsfield number was fastest in the GDC with urokinase group, then in the GDC without urokinase group, and slowest in the surgically-treated group.

Difference in the reduction was significant between the GDC with urokinase group and the surgically-treated group at day 4 (figure 3). In the Sylvian fissure, the reduction of the Hounsfield number was faster in the GDC with urokinase group, and almost same in the GDC without urokinase group and the surgically-treated group. Difference in the reduction was significant between the GDC with urokinase group and the other two groups at day 4 (figure 3).

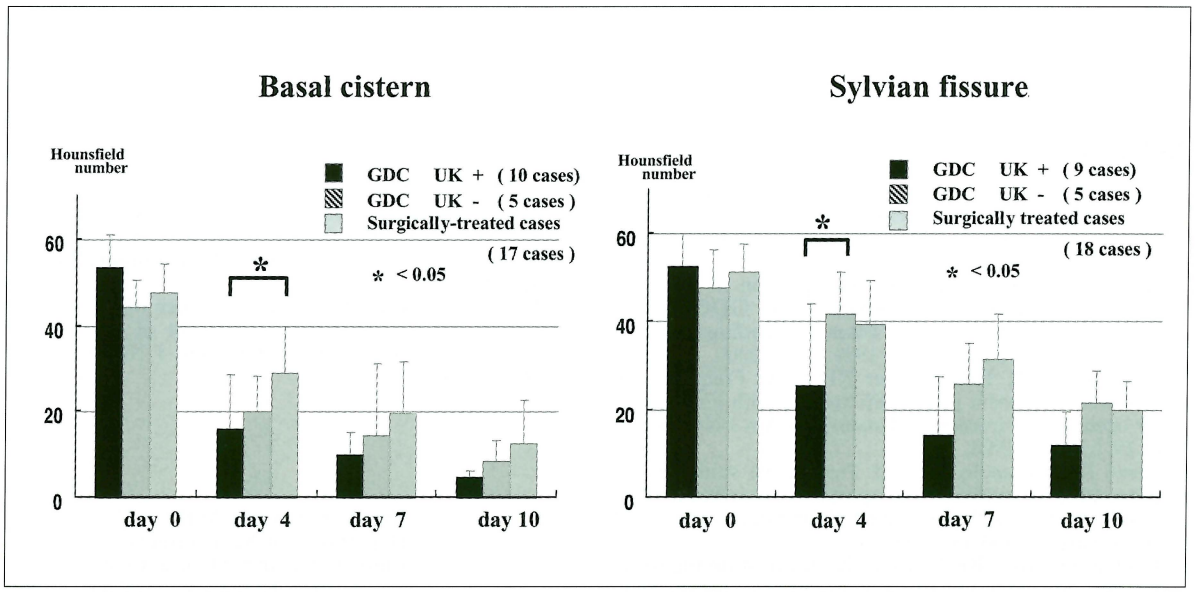

Figure 3 Serial changes in the Hounsfield number of the basal cistern (left) and the Sylvian fissure (right) in the GDC-treated group with or without intrathecal administration of urokinase (UK) and in the surgically-treated group.

Discussion

Primary brain damage caused by the initial aneurysm bleeding, rebleeding and delayed vasospasm are the major reasons for mortality and morbidity in patients with acute rupture of an intracranial aneurysm. Early surgical intervention, which is now a standard treatment of this disease, prevents subsequent aneurysm bleeding and allows to perform aggressive management against delayed vasospasm. We have performed normovolemic hyperdynamic therapy and continuous cisternal irrigation with moc-CSF containing ascorbic acid in all surgically-treated patients and have succeeded in reducing the incidence of SVS to 12%. The present study has shown that the incidence of SVS in the GDC-treated cases is still lower (6%). Yalamanchili also reported that the frequency and severity of cerebral vasospasm might be reduced in the patients treated by endovascular occlusion compared with those treated by surgical clipping[3].

Though the etiology of delayed vasospasm has not yet been fully understood, clots in the subarachnoid space apparently play an important role in its development. In the case of surgical clipping, subarachnoid clots can be directly removed during the surgery, which is not possible for endovascular treatment. However, endovascular treatment has following two advantages in early clearance of subarachnoid clots. First, the arachnoid membrane is not injured and therefore normal CSF pathways are not disturbed in endovascular treatment. Second, intrathecal administration of thrombolytic agents (urokinase or t-PA), that has been proposed as effective means to clear the subarachnoid clots[4-6], can be performed more safely. Murayama et Al. have recently reported that GDC embolization does not have an unfavorable impact on cerebral vasospasm despite the fact that subarachnoid clots cannot be removed[7].

The present study has also shown that the clearance of subarachnoid clots from both the basal cistern and the Sylvian fissure are more rapid in the GDC-treated group than in the surgically-treated group in the first four days. Intrathecal administration of urokinase further accelerated the clearance significantly.

From these observations, we conclude that endovascular treatment may be advantageous in facilitating a rapid clearance of subarachnoid clots and therefore effectively prevent the development of delayed vasospasm.

Conclusion

GDC embolization followed by intrathecal administration of thrombolytic agents facilitates the clearance of subarachnoid clots and prevents delayed vasospasm.

References

1 Kobayashi S, Satoh A et Al: Endovascular Treatment with GDC for Severe Acute SAH: Comparison with Early Direct Surgery. Interventional Neuroradiology 6 (Suppl 1): 79-84, 2000.
2 Kobayashi S, Satoh A et Al: Comparison of the incidence of symptomatic vasospam in the GDC treated cases and surgically treated cases. Proceedings of 15th. Spasm Symposium in Kyoto 1999: 85-94, 2000.
3 Yalamanchili K, Rosenwasser RH et Al: Frequency of cerebral vasospasm in patients treated with endovascular occlusion of intracranial aneurysm. Am J Neuroradiol 19: 553-558, 1998.
4 Mizoi K, Yoshimoto T et Al: Prospective study on the prevention of cerebral vasospasm by intrathecal fibrinolytic therapy with tissue-type plasminogen activator. J Neurosurg 78: 430-437, 1993.
5 Findlay JM, Weir BKA et Al: The effect of timing of intrathecal thrombolytic therapy on cerebral vasospasm in a primate model of subarachnoid hemorrhage. Neurosurgery 26: 201-206, 1990.
6 Usui M, Saito N et Al: Vasospasm prevention with postoperative intrathecal thrombolytic therapy: a retrospective comparison of urokinase, tissue plasminogen activator, and cisternal drainage alone. Neurosurgery 34: 235-245, 1994.
7 Murayama Y, Malisch T et Al: Incidence of cerebral vasospasm after endovascular treatment of acutely ruptured aneurysms: report on 69 cases. J Neurosurg 87: 830-835, 1997.

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